

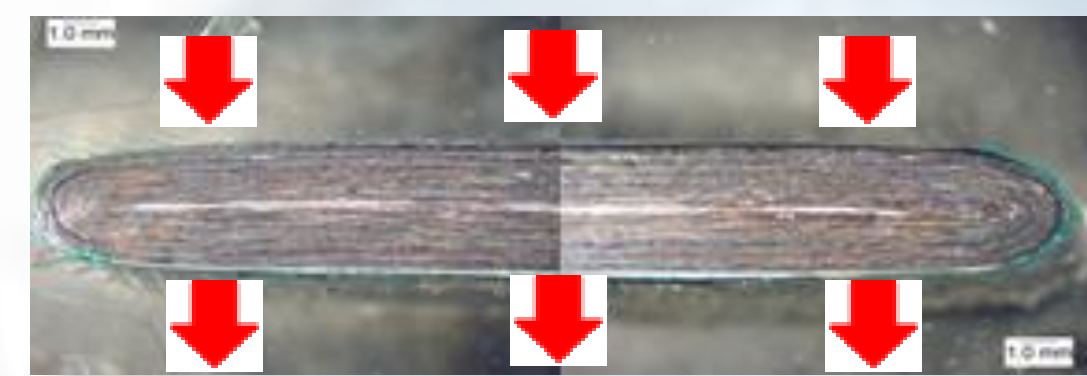
Temperature Regulation for Li-ion Cells

Hsin Wang, Sreekanth Pannala, and Srikanth Allu, Oak Ridge National Laboratory
Keith Kepler, Farasis Energy

Novel Thermal Management for Large Format, Hi-capacity Lithium-ion Cells

Concept

Thermal Conductivity of Li-ion Cells

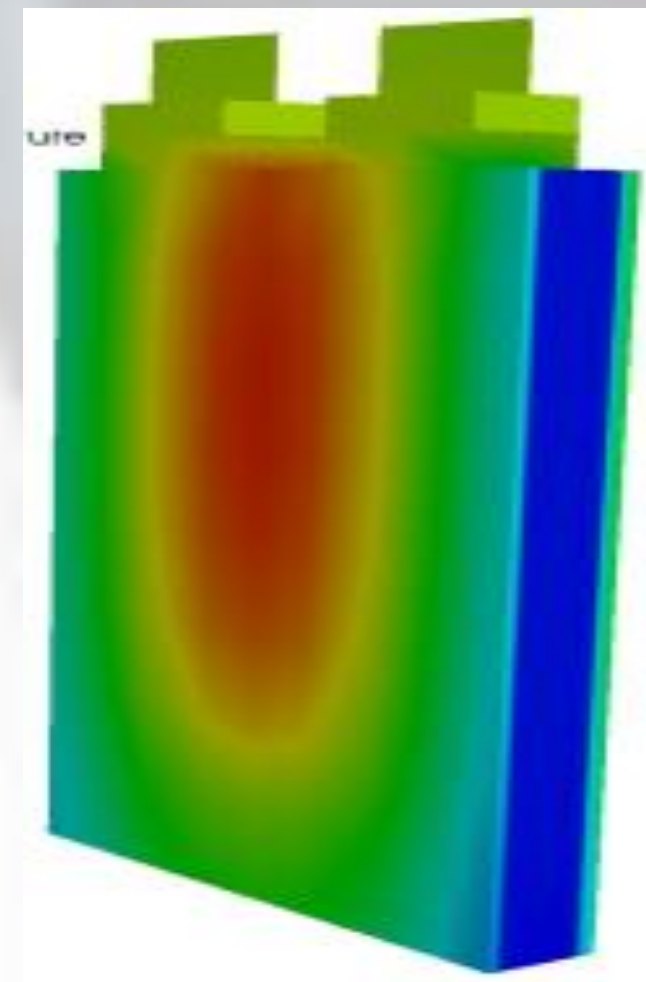


Through-thickness
 $k = 1.5 \text{ W/mK}$



In-Plane
 $k = 30 \text{ W/mK}$

Modeling



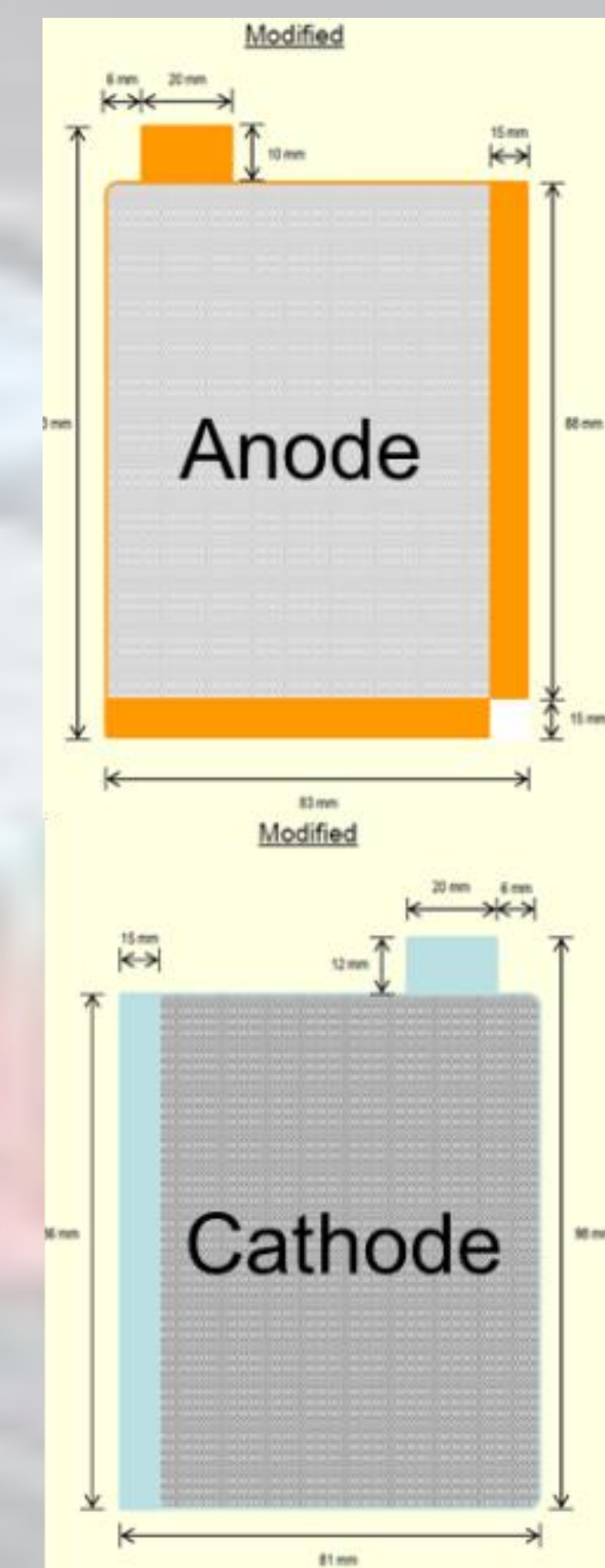
Prototype



Motivation and Design

Thermal conductivity is 20-30 times higher in-plane than through thickness in a Li-ion cell. Cell temperature can only be controlled by surface cooling.

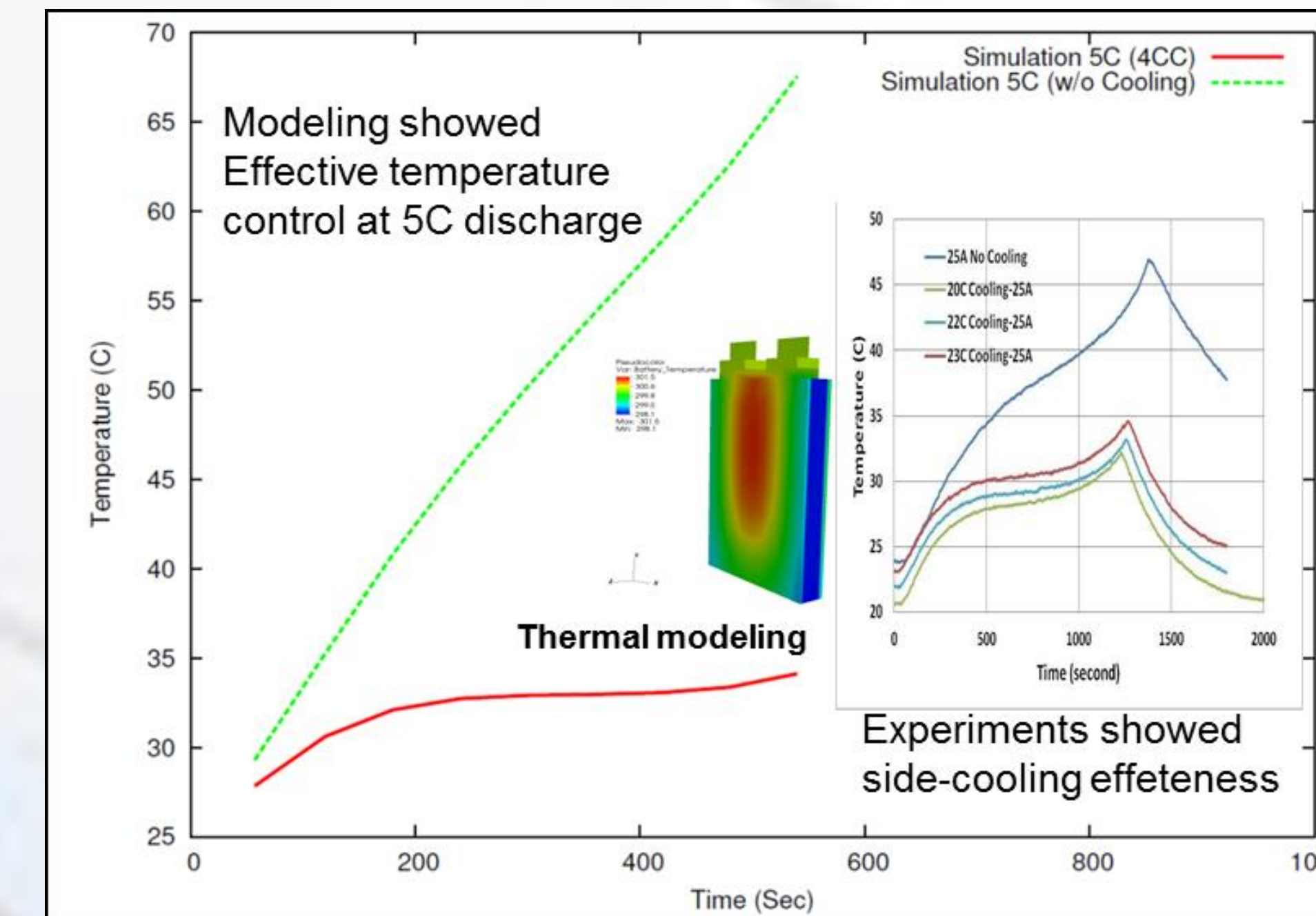
Our project is focusing on a new cell design utilizing the excellent heat conductors (Cu and Al) inside the cell to allow cooling from the side to achieve uniform temperatures throughout the cell.



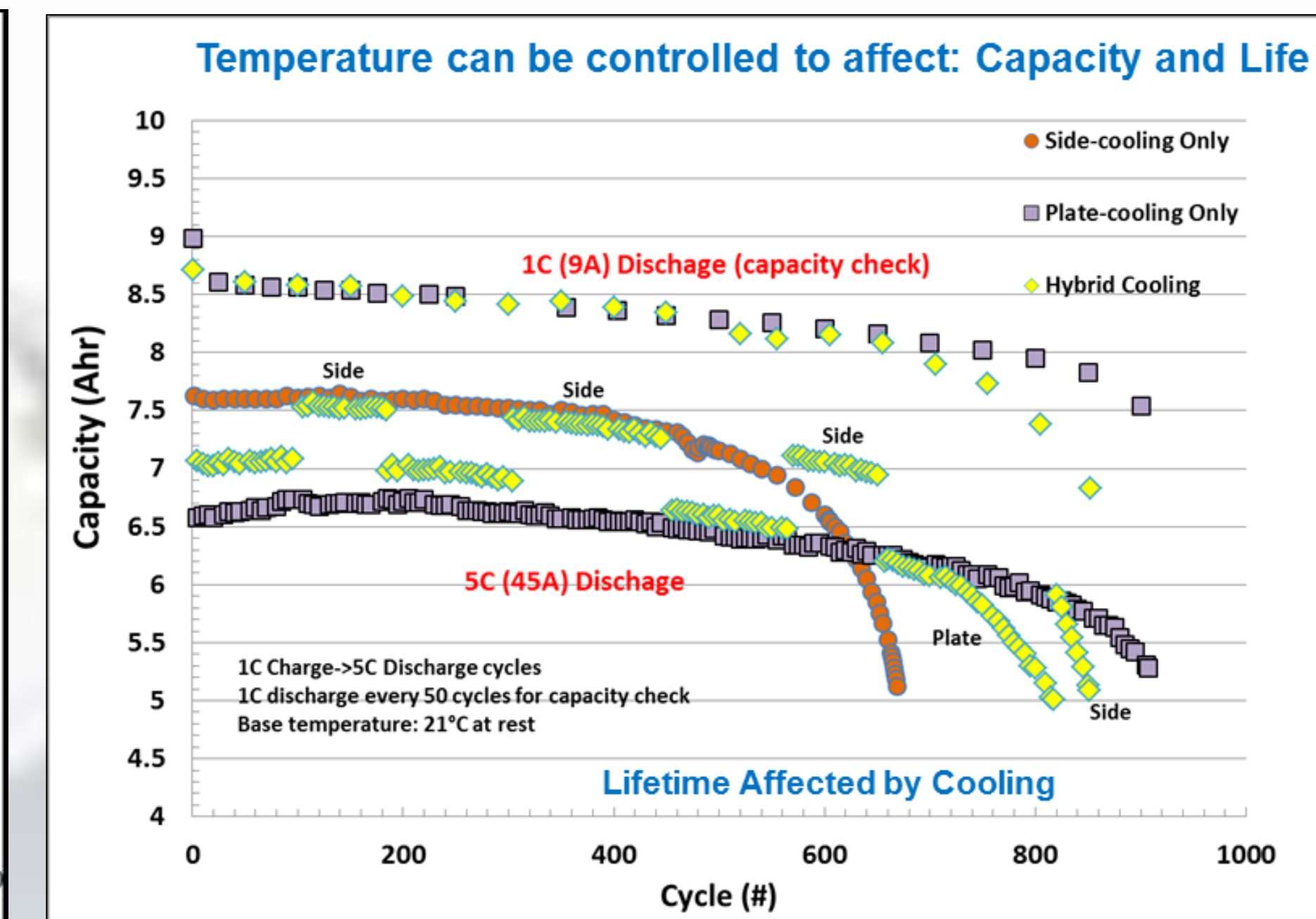
Advantages of Side-cooling

- Exploit the high conductivity of the current collectors
- Ideal for high power applications
- Can create thick cells for high capacity
- Naturally scalable to modules and pack without significant additional mechanical and other protection

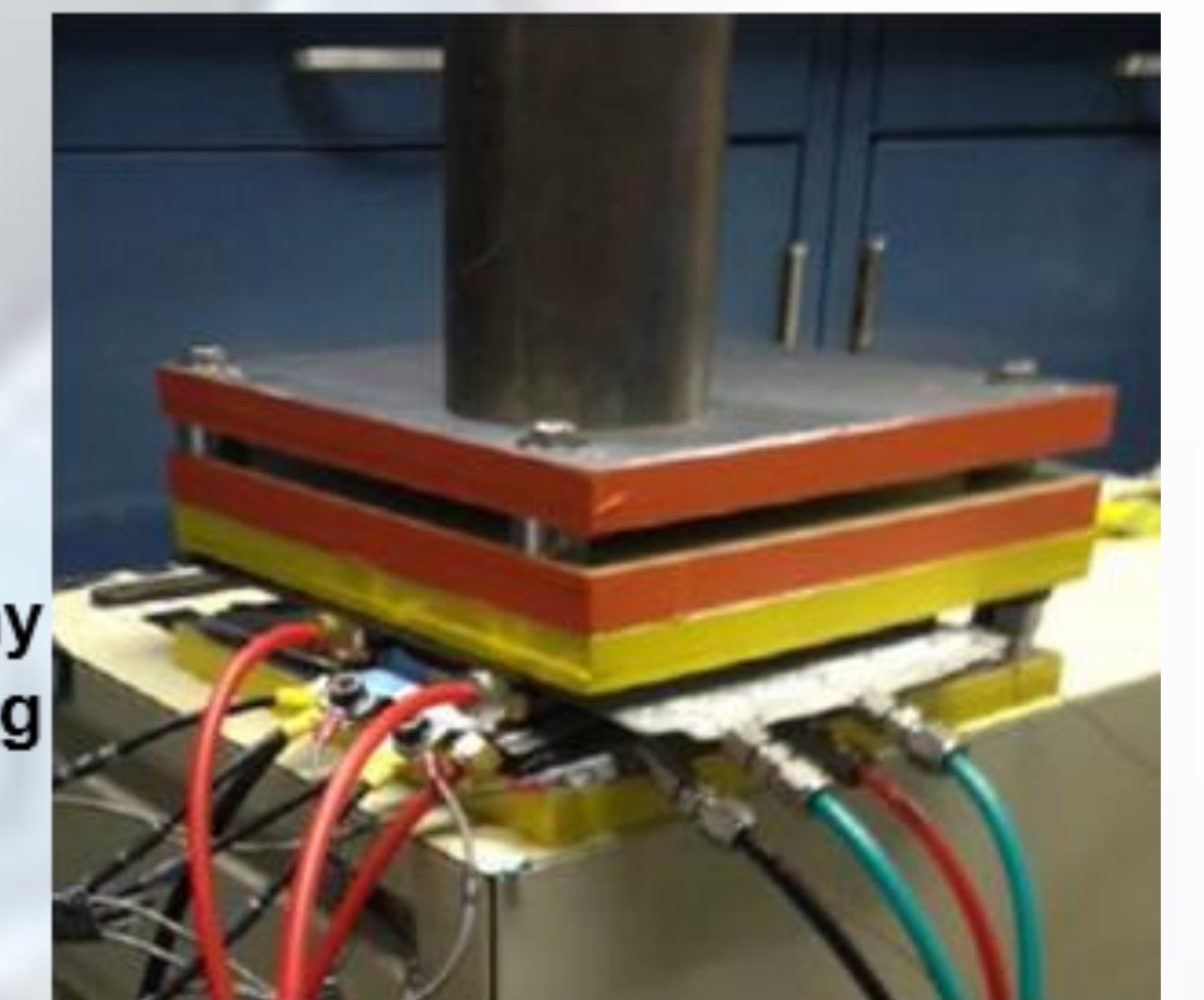
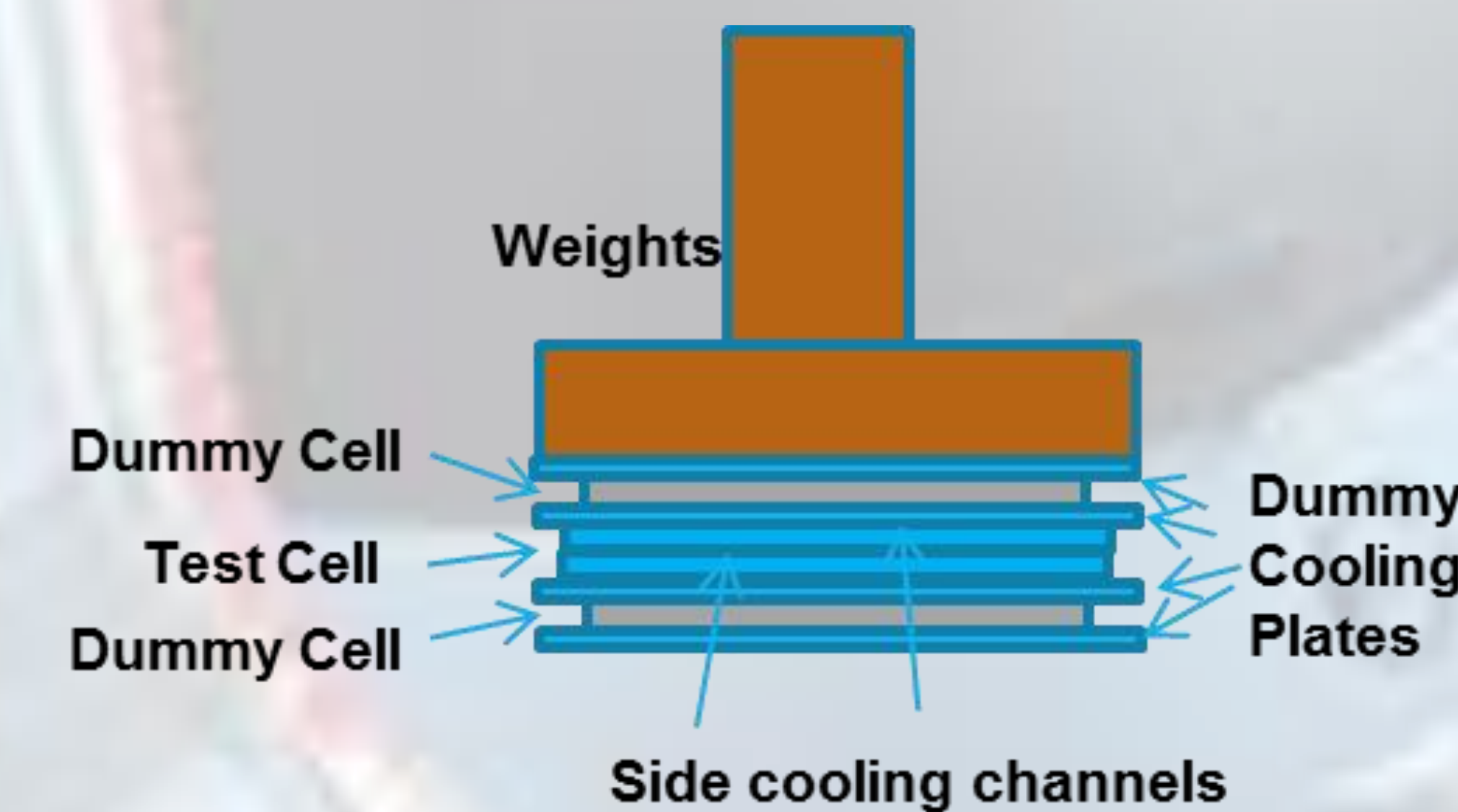
Cell Level Performance



Cycle Life

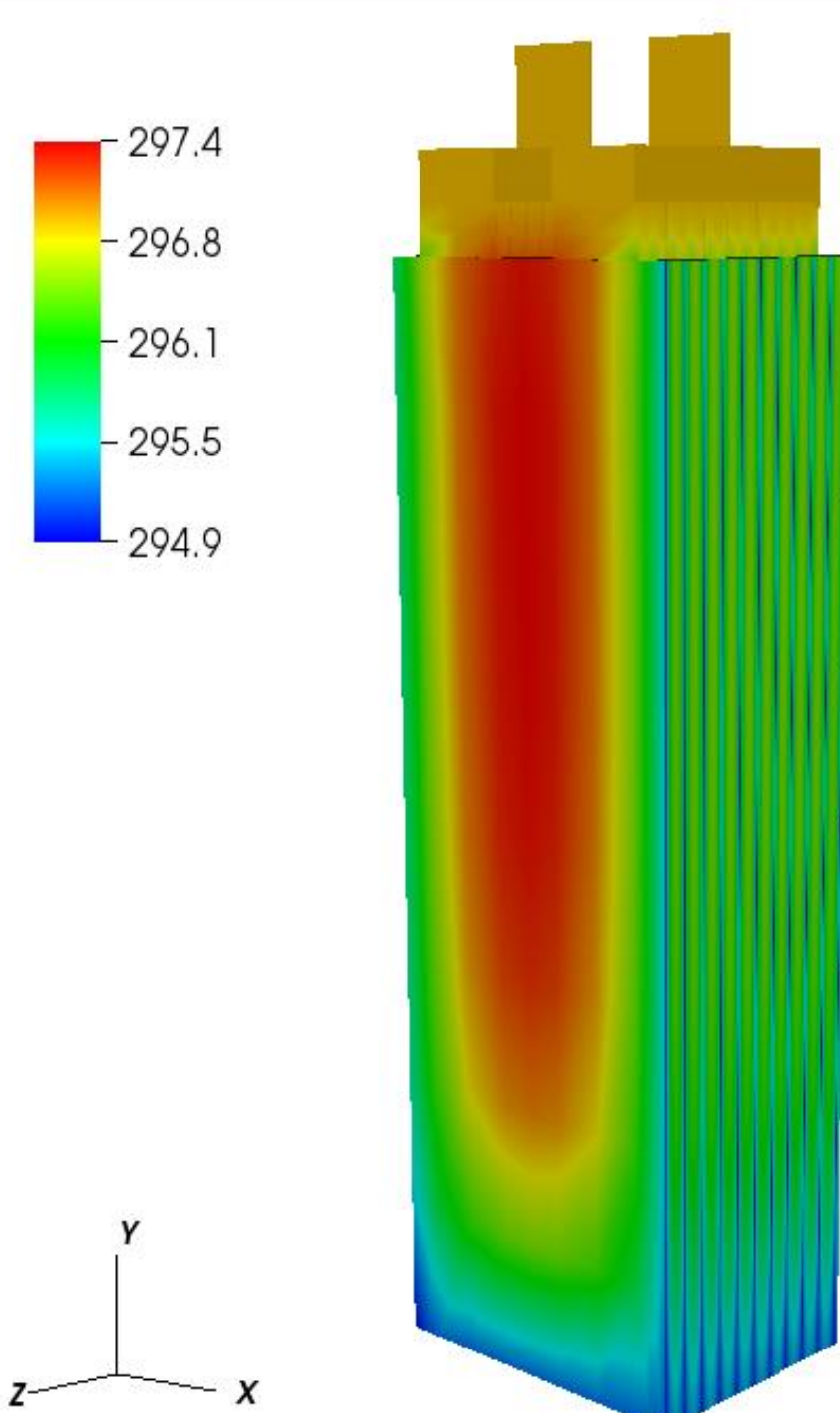


Hybrid Cooling Setup



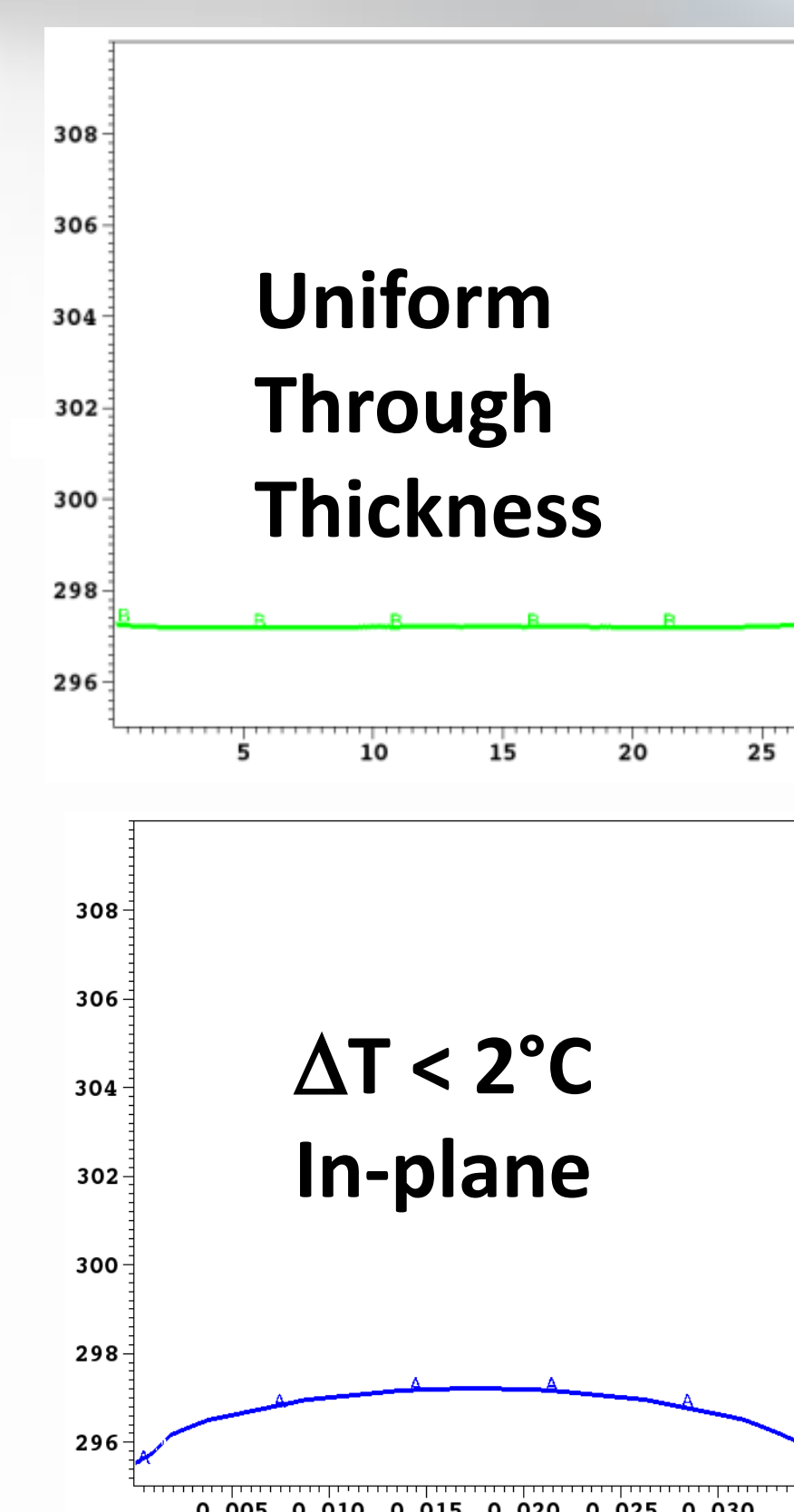
New Cell Design

New Aspect Ratio



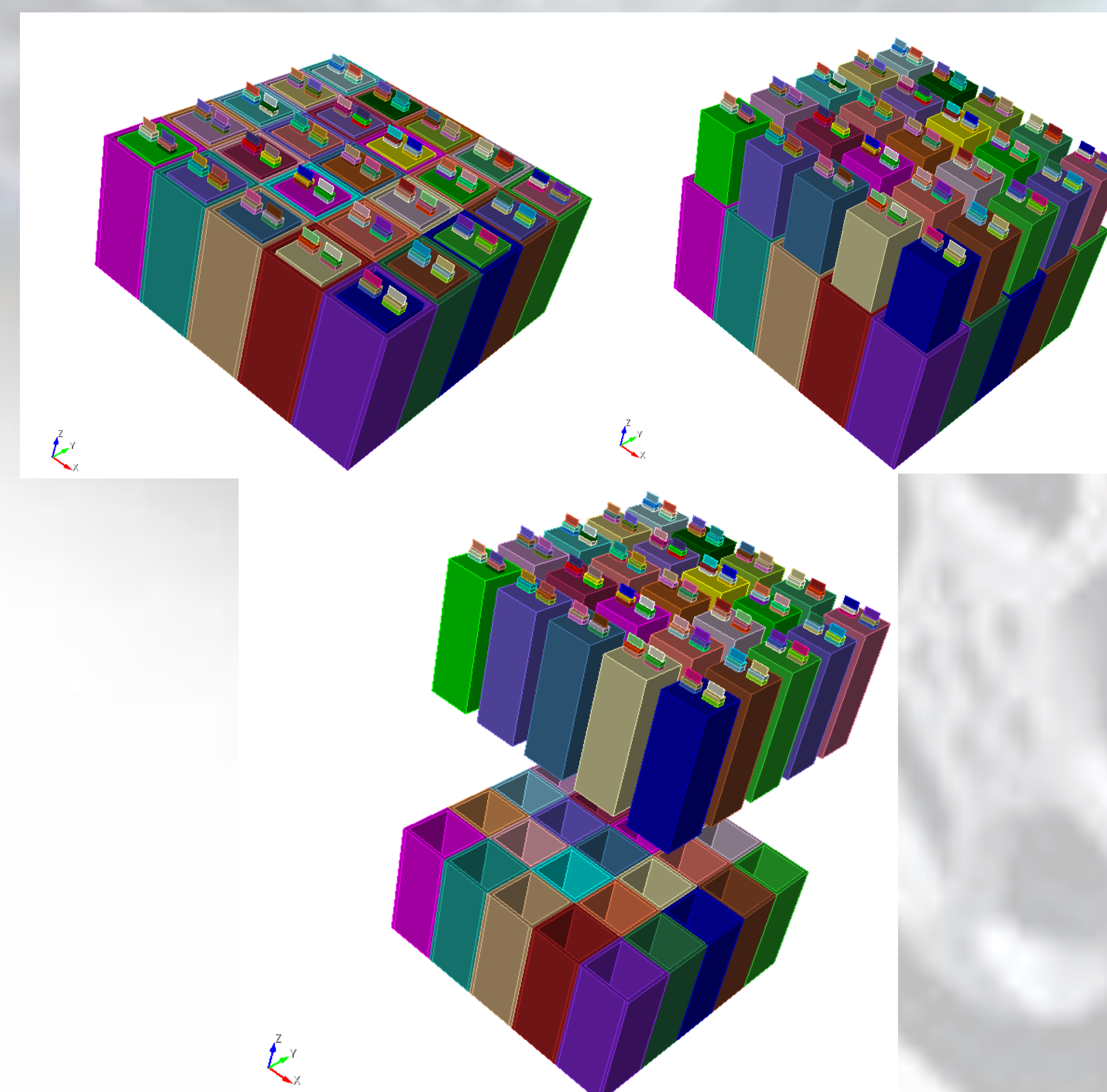
Thicker
Longer

Access to
Cu, Al from
Sides and
Bottom



- Minimum temperature gradient within each layer
- No temperature gradient through thickness

New Module Design



Advantages of New Design

- Control: Temperature control for safer and long-lasting battery
- Safety (single cell): provide faster heat removal to prevent thermal runaway, especially near cells perimeters
- Safety (cell-to-cell): Thick cell is more compressible and absorb higher impact force
- Safety (cell-to-cell): Prevent cell-to-cell fire propagation
- Multifunctional: Cooling connections can become a cellular network with mechanical properties to improve safety without adding additional weight

Team

ORNL:
Hsin Wang
(wangh2@ornl.gov)
Sreekanth Pannala
(pannalas@ornl.gov)
Srikanth Allu
(allus@ornl.gov)
Farasis:
Keith Kepler
(kkepler@farasis.com)
Dana:
John Burgers

This work is supported by DOE ARPA-E AMPED program. Patents on this technology have been filed by ORNL and Farasis. Please contact the technical lead for more information.